

# Equity Concerns in Infrastructure Financing: The Gas Tax vs. Vehicle Miles Traveled Fees

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## INTRODUCTION

The gasoline tax, which accounts for about 92.5% of revenue used for highway maintenance and improvements, is an unsustainable source of revenue for several reasons:

- It has not been raised since 1993, and because it is not indexed to inflation the amount drivers pay per mile in real terms has declined over time.
- The cost of maintaining and improving infrastructure has increased faster than the costs of other goods.
- Increasing fuel efficiency of the nation's vehicle fleet, including alternative fuels and electric vehicles, leads to a reduction in gas tax revenue.

A potential solution is to begin levying taxes on miles driven rather than gallons of gasoline consumed, which is known as a Vehicle Miles Traveled (VMT) fee.

One concern about changing the tax structure is whether such a system would be more or less regressive than the current system.

## OBJECTIVES

### 1. Determine a Revenue Neutral Flat-Rate VMT Fee for Each State

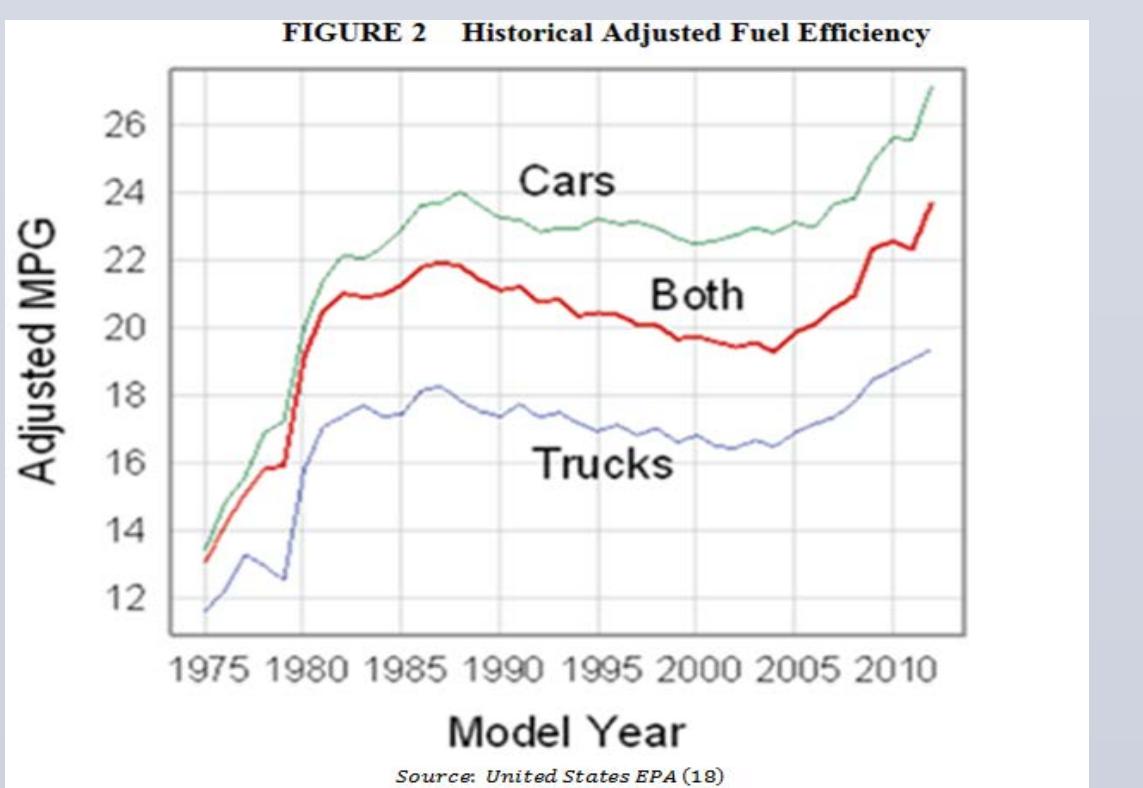
Previous studies (1) have not considered the behavioral response of drivers in calculating the appropriate fee, which could have a large impact on the amount of revenue a VMT fee would generate.

### 2. Determine Average and Range of Impacts by Demographics

Previous studies (2, 3) have suggested that retired persons and drivers in rural areas would benefit relative to other drivers, but that lower income households may pay more.

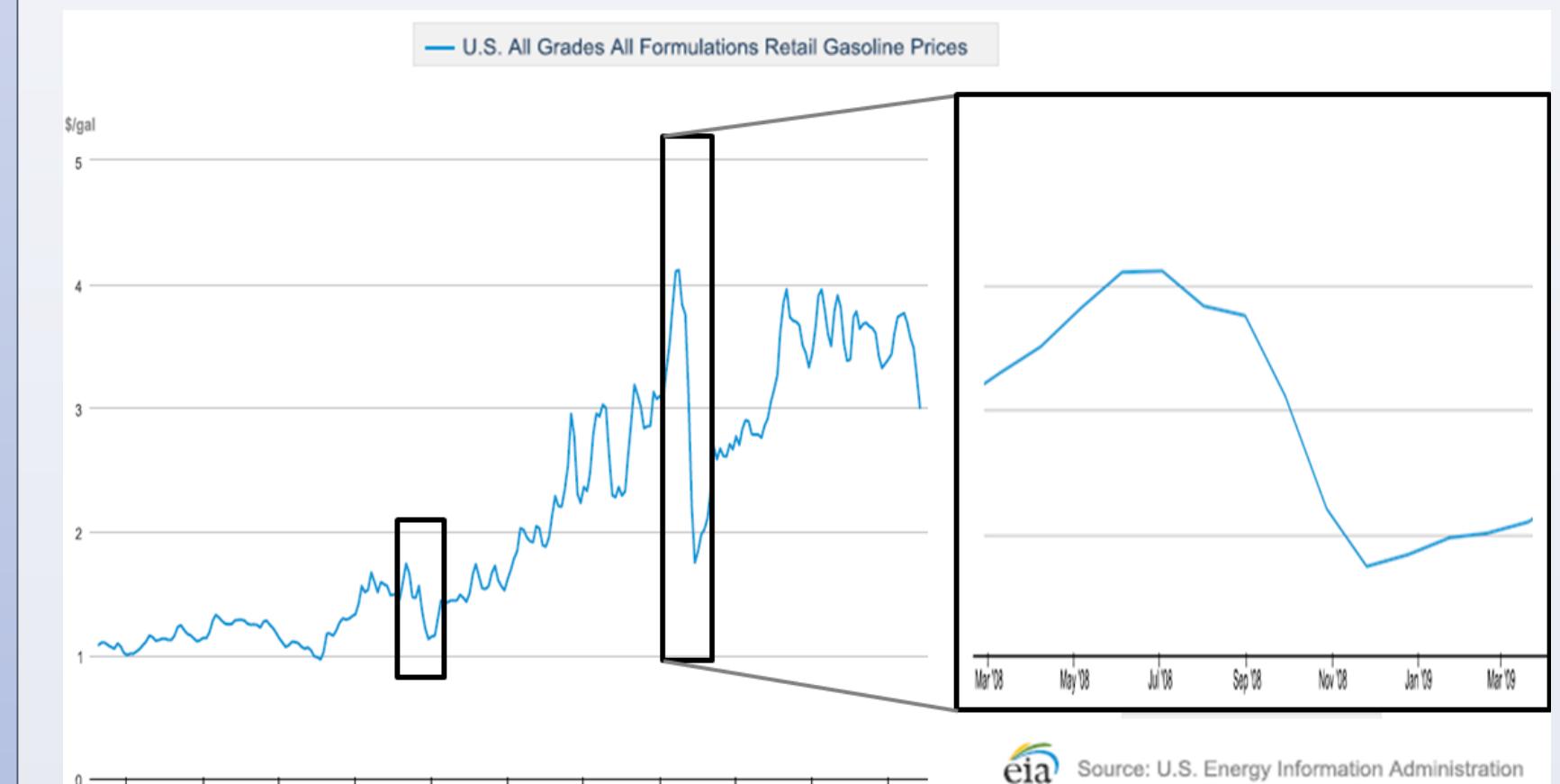
### 3. Determine How Increasing Fuel Economy Will Alter Welfare

Recent increases in fuel economy are likely to continue, as Corporate Average Fuel Economy (CAFE) standards are set to increase the fuel efficiency of new passenger cars to 35.5 MPG in 2016 and 54.5 MPG in 2025.

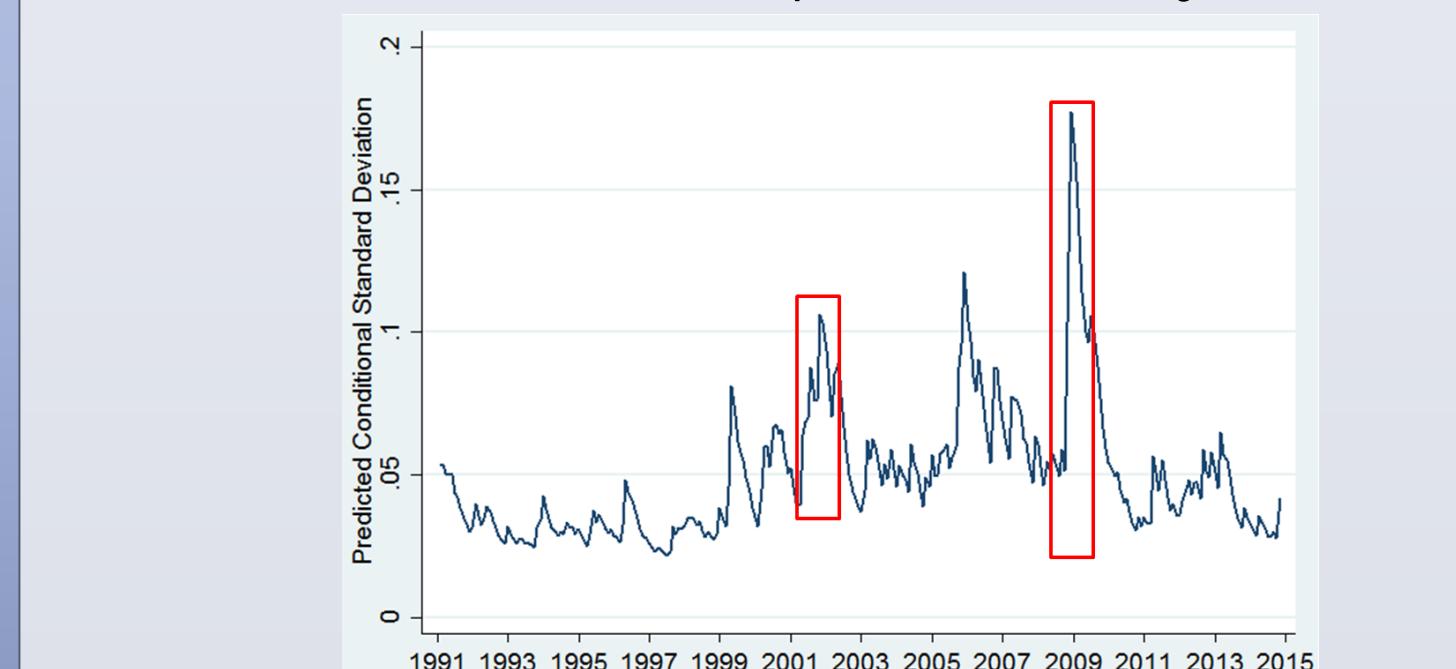


## DATA & MODEL

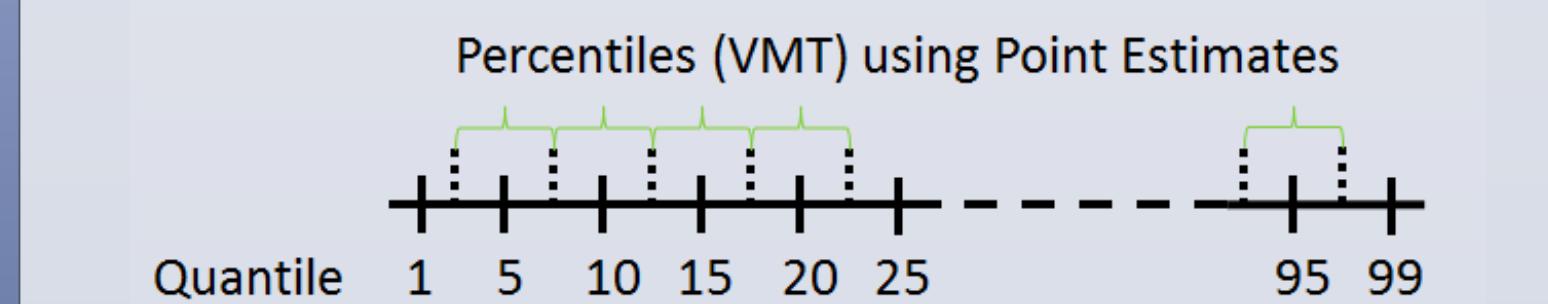
Analysis was performed on pooled cross sections from the 2001 & 2009 National Household Transportation (NHTS) Surveys.



In a first stage regression, a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model was used to obtain predicted conditional standard deviations for gasoline prices in each period, which were used to control for price uncertainty.



Separate parameters were estimated for 21 different quantiles of miles driven using quantile regression.



$$Q_\tau(\ln(Miles|X_i)) = \alpha(\tau) + \bar{\beta}(\tau) \cdot f(\ln(\frac{Price}{Mile_i})) + \bar{Y}_X(\tau) \cdot X_i + F_{\varepsilon t}^{-1}(\tau)$$

$$\min_{\alpha(\tau), \bar{\beta}(\tau), \bar{Y}_X(\tau)} \sum_{r_i > 0} \tau \cdot |r_i| + \sum_{r_i < 0} (1 - \tau) \cdot |r_i|$$

$\bar{\beta}(\tau)$  is a vector of parameters on the natural log of the price per mile and other terms interacted with it at the given quantile.

$\bar{Y}_X(\tau)$  is a vector of parameters on household demographics.

$F_{\varepsilon t}^{-1}(\tau)$  is the inverse of the distribution function of the error term.

Additional Specifications:

- Controlled for income, number & types of vehicles, etc. (See Handout)
- Fixed Effects for State, Survey Year, Month, and Day.

## OPTIMAL VMT FEE

Calculating a Revenue Neutral VMT Fee Required Solving the Following:

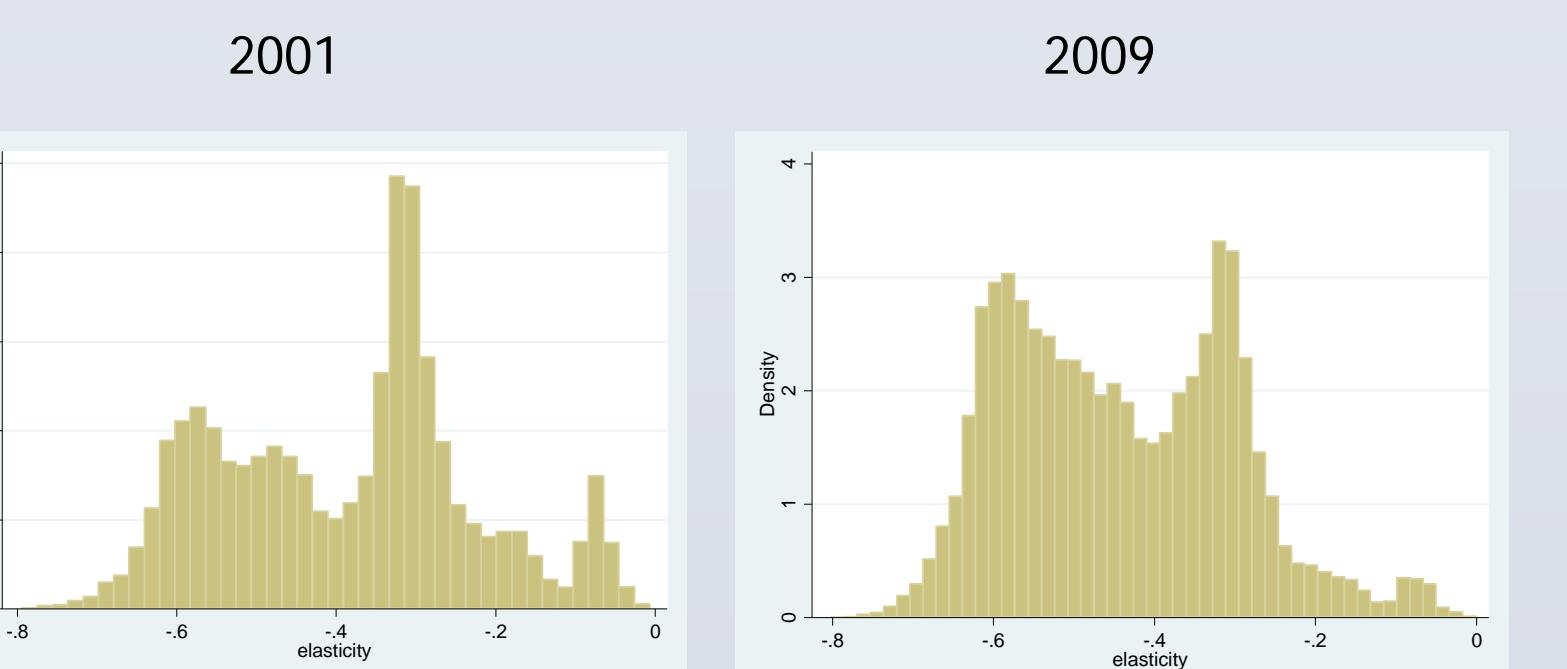
$$\sum_{i=1}^n (t_{s0}^g + t_{f0}^g) \text{gallons}_{i0} = (t_s + t_f) \sum_{i=1}^n \text{miles}_{i0} (1 + \varepsilon_i (\% \Delta \text{price}_m))$$

## RESULTS BY HOUSEHOLD

Regression Results by Quantile of Miles Driven

VARIABLES	(1) q05	(2) q10	(3) q15	(4) q20	(5) q25	(6) q30	
In(cents/mi)	-0.895*** (0.0317)	-0.823*** (0.0179)	-0.755*** (0.0154)	-0.694*** (0.0134)	-0.661*** (0.0135)	-0.633*** (0.0135)	
In(cents/mi)*mpg	0.0167*** (0.00225)	0.0167*** (0.00225)	0.0158*** (0.00225)	0.0151*** (0.000748)	0.0144*** (0.000682)	0.0138*** (0.000753)	
In(cents/mi)*age	-0.00211*** (0.00121)	-0.00211*** (0.000384)	-0.00211*** (0.000384)	-0.00211*** (0.000384)	-0.00211*** (0.000384)	-0.00211*** (0.000384)	
In(cents/mi)*income	5.21e-07 (5.72e-07)	-4.21e-08 (3.89e-07)	8.6e-08 (3.45e-07)	8.01e-08 (2.40e-07)	5.50e-07 (2.20e-07)	7.61e-07*** (2.09e-07)	
VARIABLES	(7) q35	(8) q40	(9) q45	(10) q50	(11) q55	(12) q60	
In(cents/mi)	-0.604*** (0.0311)	-0.572*** (0.0171)	-0.538*** (0.0154)	-0.511*** (0.0134)	-0.485*** (0.0135)	-0.467*** (0.0135)	
In(cents/mi)*mpg	0.0132*** (0.000539)	0.0124*** (0.000524)	0.0118*** (0.000476)	0.0112*** (0.000535)	0.0102*** (0.000643)	0.00938*** (0.000573)	
In(cents/mi)*age	-0.00317*** (0.000487)	-0.00322*** (0.000422)	-0.00291*** (0.000444)	-0.00269*** (0.000329)	-0.00254*** (0.000292)	-0.00215*** (0.000292)	
In(cents/mi)*income	9.90e-07*** (2.04e-07)	1.05e-06*** (1.57e-07)	1.00e-06*** (1.10e-07)	9.68e-07*** (9.77e-08)	7.98e-07*** (1.23e-07)	7.24e-07*** (1.14e-07)	
VARIABLES	(13) q65	(14) q70	(15) q75	(16) q80	(17) q85	(18) q90	(19) q95
In(cents/mi)	-0.454*** (0.00692)	-0.441*** (0.00721)	-0.429*** (0.00988)	-0.429*** (0.00678)	-0.421*** (0.00797)	-0.429*** (0.00857)	-0.445*** (0.0166)
In(cents/mi)*mpg	0.00867*** (0.000533)	0.00843*** (0.000401)	0.00808*** (0.000421)	0.00835*** (0.000517)	0.00813*** (0.000547)	0.00870*** (0.000530)	0.00920*** (0.000447)
In(cents/mi)*age	-0.00148*** (0.000356)	-0.00148*** (0.000369)	-0.00148*** (0.000378)	-0.00148*** (0.000366)	-0.00148*** (0.000320)	-0.00148*** (0.000470)	-0.00148*** (0.000703)
In(cents/mi)*income	5.05e-07*** (1.32e-07)	4.02e-07*** (1.50e-07)	2.75e-07*** (1.38e-07)	1.99e-07 (1.73e-07)	3.39e-07*** (1.95e-07)	5.30e-07*** (2.09e-07)	6.48e-07*** (2.64e-07)

Estimated Elasticities

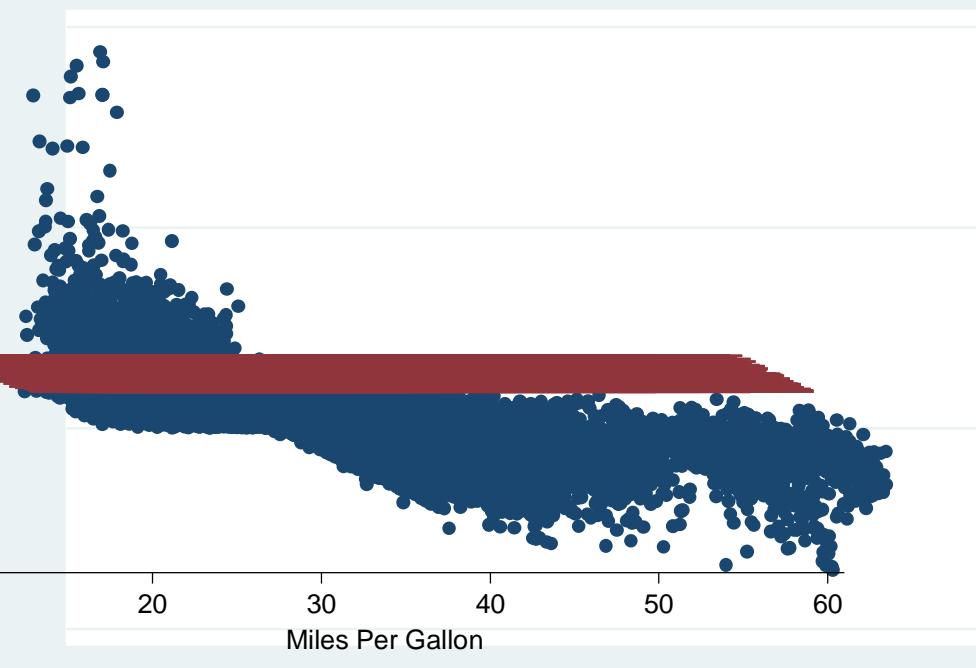


Change by Rural vs Urban

TABLE 4: Average Annual Consumer Surplus Change based on Location and Whether Retired (\$/HH)							
Household Income	Rural	Urban	Full Sample				
\$5,000 to \$24,999	-1.46	-21.74	-12.15	1.26	-18.49	-9.96	-10.61
\$25,000 to \$49,999	17.47	-3.77	2.12	5.82	-15.72	-8.38	-5.43
\$50,000 to \$74,999	24.20	13.28	15.12	6.90	-8.98	-6.34	-1.03
\$75,000 to \$99,999	2.37	1.12	1.25	-2.22	-9.48	-8.62	-6.61
More than \$100,000	14.71	27.37	25.87	7.06	8.41	8.27	11.15
2009							
\$5,000 to \$24,999	7.80	-1.77	4.08	5.69	-2.34	-2.45	2.99
\$25,000 to \$49,999	10.55	-3.26	3.64	3.95	-4.13	-0.01	1.15
\$50,000 to \$74,999	9.84	-3.67	0.83	7.47	-4.49	-0.17	0.14
\$75,000 to \$99,999	13.45	-1.16	2.36	4.71	-5.74	-3.01	-1.40
More than \$100,000	5.04	-2.41	-0.90	7.22	-4.71	-2.38	-2.00

## RESULTS BY VEHICLE (2009)

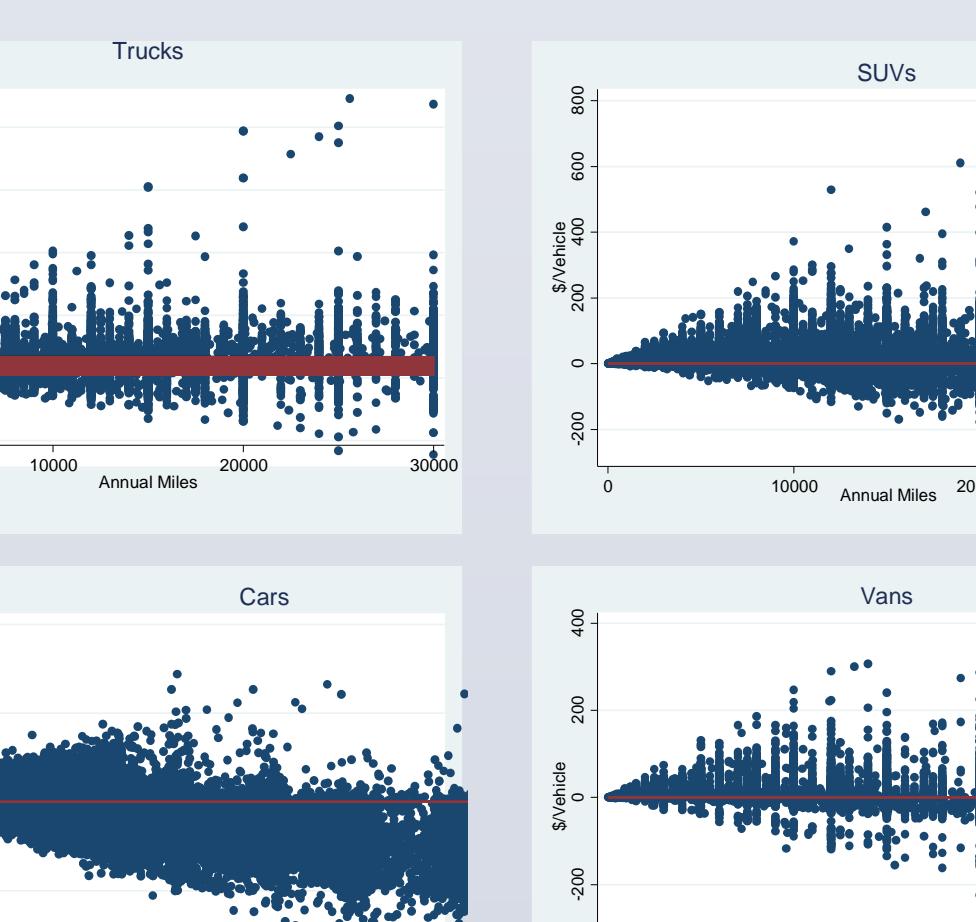
Change in Consumer Surplus by Fuel Efficiency Within Sample



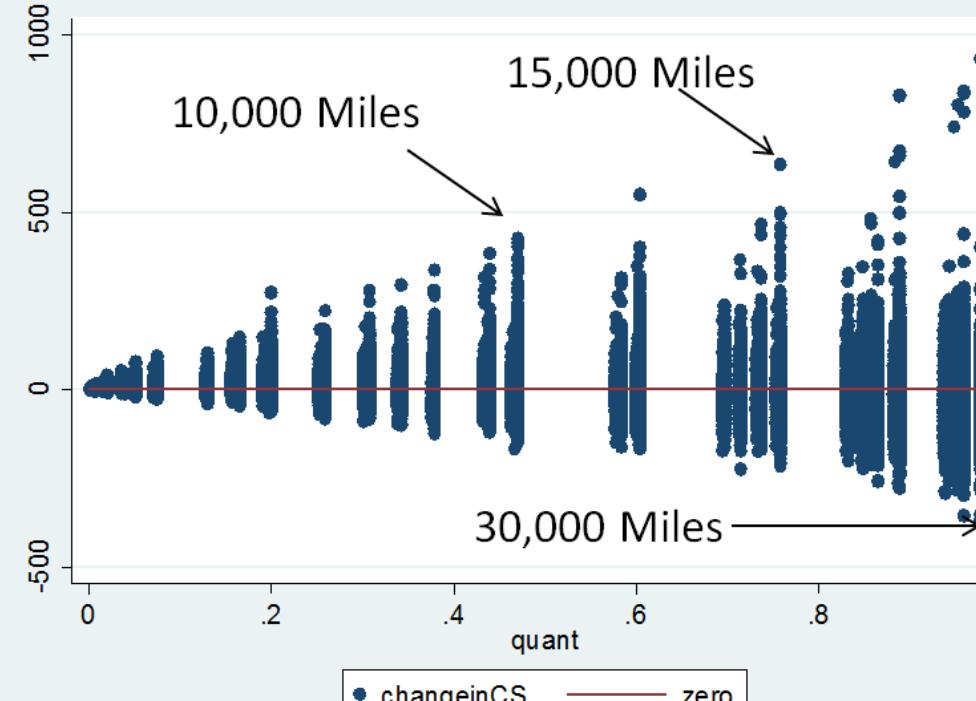
Average Change in Consumer Surplus by Vehicle Type



Change in Consumer Surplus by Vehicle Type Within Sample



Change in Consumer Surplus Per Vehicle by Annual Mileage



## CONCLUSIONS

- Given accurate information on elasticities, it is possible to determine a revenue neutral fee to replace both the state and federal gas taxes with a VMT fee at the state level.
- Apparent benefits to rural and retired drivers are no longer significant, and the range of change in consumer surplus is considerably smaller in the recent data.
- It appears that recent increases in fuel efficiency have made a VMT fee slightly less regressive with respect to income.

This is likely because higher income households are more likely to have newer vehicles. As fuel economy of new vehicles continues to increase, this trend is likely to continue.

## REFERENCES

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